TECHNICAL MEMORADUM

Assignment of HPMS Functional Classification and Posted Speed Limit Attributes to the Atlanta Regional Commission Highway Network

1.0 Introduction

Reasonable estimates of travel speeds based on the latest available data are necessary to effectively calculate motor vehicle emissions in the Atlanta region. A post processor to the regional Travel Demand Model (TDM) was developed by Wilbur Smith Associates and integrated into the emissions model to improve speed estimates derived directly fom the travel model. EPA Guidance recommends post-processing speeds from the output of the local travel demand model (*Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources. EPA-450/4-81-026d).* Key inputs to the post processor include Highway Performance Monitoring System (HPMS) functional classification codes and posted speed limits.

Although HPMS functional classification codes are coded for each link in the highway network within ARC's Transportation Network Management System (TNMS) database, the ARC travel demand model does not report loaded network assignment results by HPMS functional classification. This is due to field limitations within the travel model that limit how many link attributes may be reported, despite how many are coded within the TNMS database.

Currently, posted speed limit is not an attribute in the (ARC) regional travel demand model. To fully implement the new algorithms in the post processor, it was necessary to update the HPMS coding and append posted speed limit data for each link in the transportation network. The current Road Characteristic (RC) database, maintained by Georgia Department of Transportation (GDOT), hosts the HPMS classification and the posted speed limit data

ARC Network
The ARC network is a linear representation of the roadway system in the Atlanta region. Performance measures for the region, specifically vehicle miles of travel (VMT) and vehicle hours of travel (VHT), are derived from the assignment of trips to the roadway networks. Highway network statistics are reported by assignment group and area type rather than by HPMS functional class. Because the HPMS code was never utilized for reporting procedures, the HPMS field coded for each link was not maintained over time within the TNMS database.

Road Characteristics (RC) Database
The RC database is an inventory of roadway characteristics for all public facilities in Georgia. The information is used to maintain state, county, and city maps. The roadway network is segmented by mile marker and includes, but is not limited to, geographic location, geometric characteristics, operation characteristic, maintenance responsibilities, and historical traffic count information.

Digital Line Graphic – Feature (DLG-F) Spatial Data File
The DLG-F file is the geography of the roadway infrastructure segmented into the same slices as the RC data.

The RC data and DLG-F files were joined to form a single layer of data that was used to attribute HPMS functional class codes and posted speed limit data to corresponding links in the ARC networks. . The RC database was joined to the current (1999) Digital Line Graphic -Feature (DLG-F) geography by digital line segment, for the 13 counties in the Atlanta region. . A data attribution methodology was chosen that provided relatively accurate results in a short time frame. A longer schedule would have permitted a more extensive methodology that would have included an additional validation mechanism and allowed for additional posted speed limit data collection.

2.0 Assignment of HPMS Functional Class Codes

The HPMS is a characteristic database of the nation's roadway system. One of the data items included in the database is functional classification. A description of the functional class codes in the HPMS database is presented in Table 2.1

Table 2.1
Function System Code

Code	Description
Rural	
01	Principal Arterial – Interstate
02	Principal Arterial – Other
06	Minor Arterial
07	Major Collector
08	Minor Collector
09	Local
Urban	
11	Principal Arterial –Interstate
12	Principal Arterial – Other Freeways and Expressways
14	Principal Arterial – Other
16	Minor Arterial
17	Collector
19	Local

Source: FHWA Order M 5600.1B: August 30, 1993

Methodology
The ARC network, which is a linear representation of the roadway system, was re-projected using ArcView so that it could be overlaid with the DLG-F geography. The ARC network was then populated with "first cut" HPMS codes. The DLG-F and ARC networks were overlaid on top of each other, and the HPMS codes from the RC database and "first cut" HPMS codes from the ARC network were thematically mapped. A visual inspection by county revealed the links that were correctly assigned, and those that were mismatched. In the instances where the RC and ARC did not match, the ARC network was changed to reflect the RC code. HPMS functional classification, a federally recognized classification technique used for air quality analyses dictated that the HPMS codes described in the RC database would always rule the attribution procedure. A flow chart presenting the methodology for assigning HPMS codes is presented in Figure 2.1

Year 2000 "First Cut" Functional Class Attribution
The first cut methodology allowed the attribution of HPMS codes based on the functional classification and area type, as currently coded into the regional model. This assignment provided a "best guess" based on attributes in the model, and prevented initial individual link assignments. The "first cut" assumptions are presented in the Table 2.2.

Figure 2.1
HPMS Functional Class Code Attribution Methodology

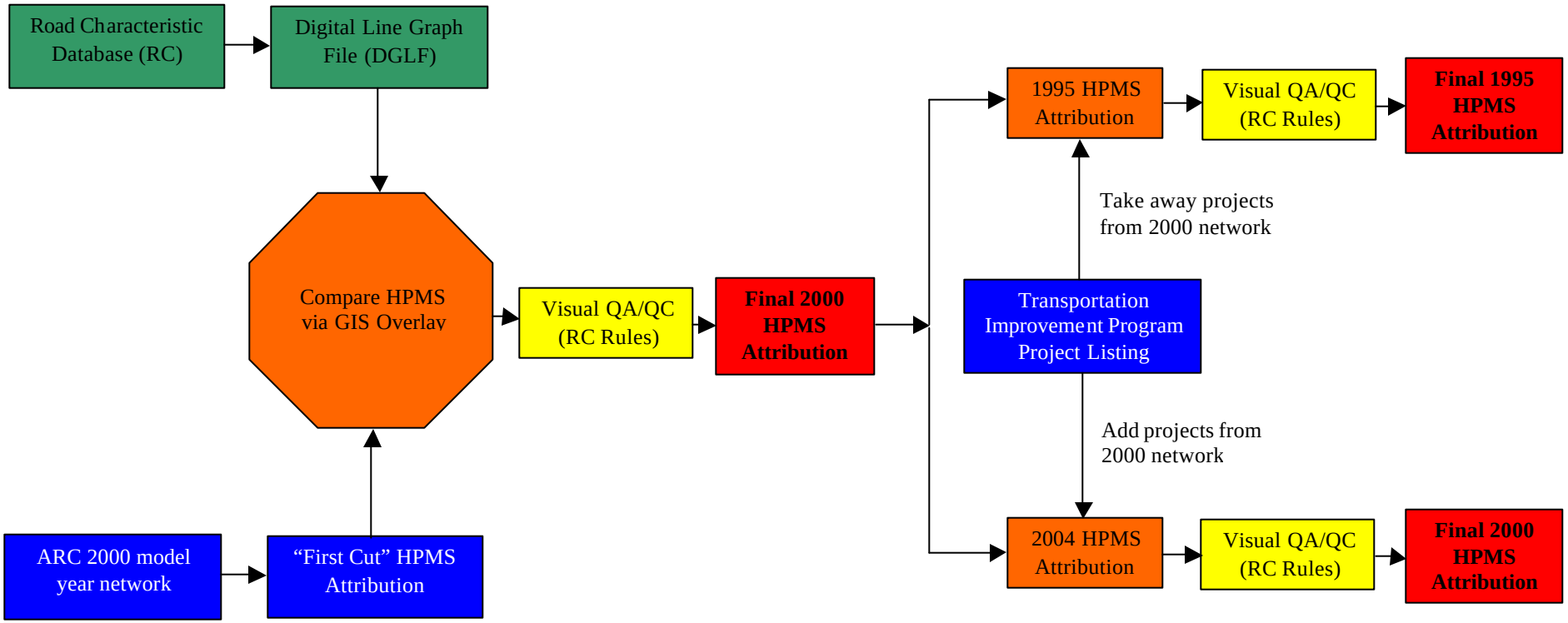


Table 2.2
Preliminary HPMS Codes
Based on Functional Classification and Area Type

ARC Facility Type	ARC Assignment Group	Initial or "first cut" HPMS Assignment codes	
		Link Group 2 = 1-6 (Urban)	Link Group 2 = 7 (Rural)
Interstate	1	11	1
Expressway/HOV	2	11	1
Parkway	3	12	2
High Speed Ramp	4	22	21
Low Speed Ramp	5	24	23
Class I Arterial	6	14	2
Class II Arterial	7	16	6
Class III Arterial	8	16	6
Class I Collector	9	17	7

Year 2000 HPMS Functional Class Attribution
Since the DLG-F and RC data sources are 1999 vintage, year 2000 HPMS functional class codes were the first to be assigned. Each county was mapped individually, and a visual inspection of RC HPMS codes and "first cut" HPMS functional class codes was made. Any discrepancies in the initial coding were modified to reflect the RC database. The majority of the higher classed facilities (e.g. freeways) matched well with the initial assignment. The Class III Arterial and Collectors were not consistent. Each attributed link in the 2000 network was independently checked for quality assurance.

Year 2004 HPMS Assignments
The final 2000 network HPMS functional class codes were used as a seed for the 2004 network. All of the links with the same A-node and B-node were given the same HPMS functional class code as the year 2000. Links that were new in the 2004 network were assigned a code based on the "first cut" methodology, with the links that that were eliminated in 2004 network were omitted. As a secondary check, ARC provided a database of projects that are schedule to be completed by 2004 (see Appendix A). This list included facility upgrades as well as new facilities. For each of the projects listed in the database the associated links in the ARC model network, and their attributes, were noted. The ARC speed/capacity matrix was used to review the changes in capacity and/or speed and to validate the functional dassifications and area types. If a new/improved facility exhibited changes in speed and/or capacity that warranted changes in functional classification and/or area type, the HPMS functional class attribution was reviewed, and the appropriate adjustments were made. The speed/capacity matrix used in the review of the proposed projects is presented in Table 2.3

Table 2.3
Speed/Capacity Matrix
(Hourly capacity/Off peak free-flow speed)

Facility Type	Area Type						
	CBD	Urban High Density – Commercial	Urban High Density - Residential	Suburban High Density - Commercial	Suburban High Density - Residential	Exurban	Rural
Freeway	1700/55	1800/60	1900/63	1900/65	1900/65	2000/65	2200/70
Expressway	1700/50	1800/55	1900/60	1900/60	1900/62	2000/65	2200/65
Parkway	1700/50	1800/55	1900/60	1900/60	1900/62	2000/65	2200/65
High Speed Ramp	1200/25	1300/30	1350/35	1400/35	1450/38	1600/41	1700/53
Low Speed Ramp	500/15	500/25	625/26	625/26	750/33	750/33	950/35
Class I Arterial	1300/25	1300/30	1400/35	1550/35	1700/38	1750/41	1800/53
Class II Arterial	1100/20	1200/27	1250/30	1300/30	1350/33	1400/33	1400/39
Class III Arterial	1000/15	1050/25	1100/26	1150/26	1200/33	1250/33	1350/35
Class I Collector	850/8	850/25	900/27	950/27	1000/26	1050/33	1100/37

Source: Atlanta Regional Commission – Procedure Guide

Year 1995 HPMS Functional Class Attribution
The same methodology was performed to seed the 1995 network. Once again, all of the links with the same A-node and B-node were given the same HPMS functional class code as the 2000 network. Links that were unique to the 1995 network were assigned a code based on the "first cut" methodology, and the links that that were eliminated in 1995 network were omitted. The project database was consulted, and projects that were implemented between 1995 and 2000 were revisited to check the correct HPMS assignment (see Appendix B).

Observations, Findings and Recommendations
In some instances, primarily the interstate facilities, the RC database failed to provide a definitive HPMS code. Therefore, the first cut methodology was used without validation from a secondary source. Within the Federal HPMS functional class hierarchy, the interstate facilities are defined as 01 or 11 depending on area type (e.g. 01 for urban, 11 for rural). Knowing the precise geographic location and coding of the interstate facilities instilled confidence that the correct functional classification was used in the assignment of the HPMS functional class codes. The urban/rural area type was taken directly from the ARC model attributes. The other major observation was the coding of all ramps as local facilities. All cases in the RC database assigned a local designation to the ramp and CD systems. It would be more accurate to separate the ramps into high and low speed varieties, similar to the existing designation in the ARC model. It is recommended that ramps that do not employ traffic control devices, or that connect interstate type facilities to interstate type facilities, would be separated from lower classified facilities. The ramps to/from access controlled facilities would receive the same HPMS code, but not necessarily the same posted speed limit, as the facilities the ramp is connecting. Similarly, the ramps that provided access from interstate type facilities to arterials and collectors would maintain the local designation. These are general rules of thumb and could be changed on a case-by-case basis.

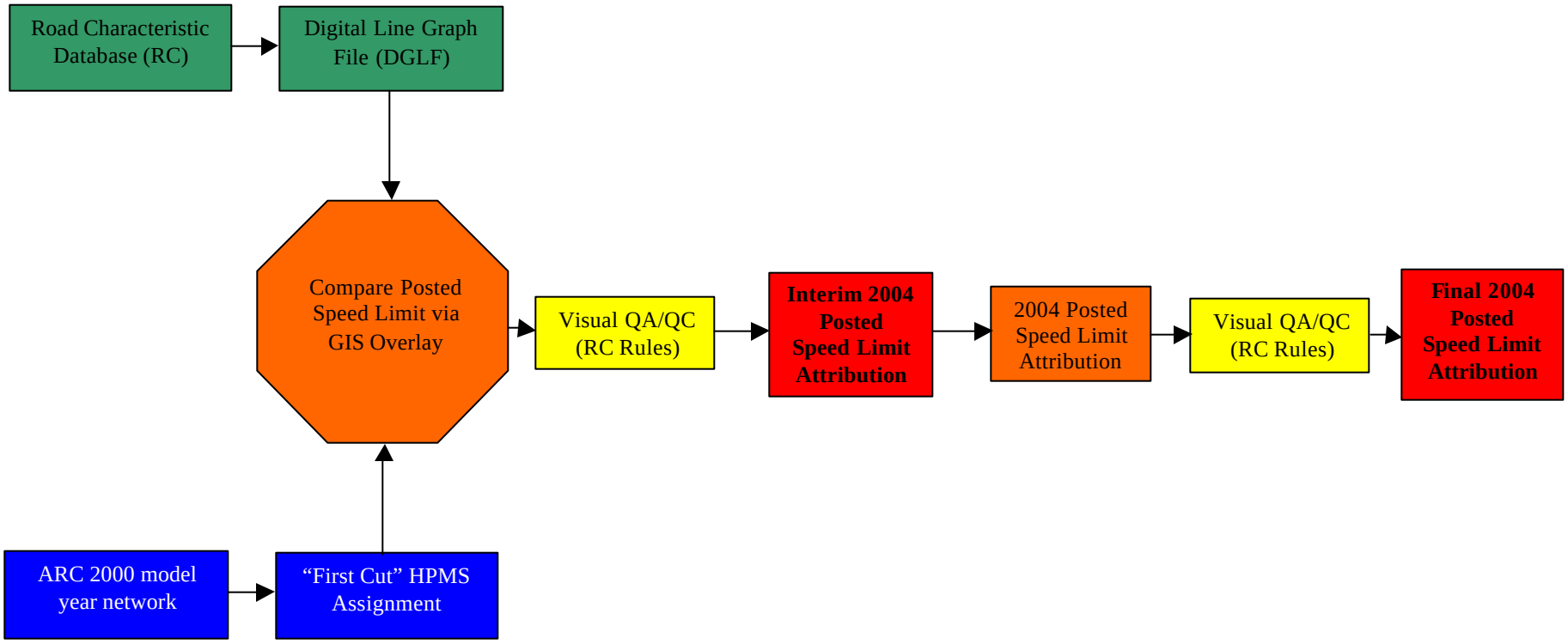
3.0 Assignment of Posted Speed Limit

Methodology for Attribution Posted Speed Limit
The same methodology as the HPMS assignments was employed to append posted speed limit data to the ARC travel demand model highway network. Once again the ARC network was re-projected to overlay the DLG-F geography. The ARC 2004 year network was then populated with "first cut" posted speed limit data. The DLG-F and ARC networks were then overlaid on top of each other, and the posted speed limit from the RC database and "first cut" codes from the ARC network were thematically mapped. A visual inspection by county revealed the links that were correctly assigned, and those that were mismatched. In the instances where the RC and initially assigned posted speed limit codes were different, the ARC network was changed to reflect the RC database. A flow chart presenting the methodology for assigning post speed limit codes is presented in Figure 3.1.

"First Cut" Attribution
The "first cut" posted speed limit data was derived from the adjusted free flow speeds in the year 2004 off peak highway network. The adjusted speeds were rounded to the nearest 5 mph, with a 25 mph minimum. This procedure provided a "best guess" based on attributes in the model and prevented initial individual link assignments.

Year 2004 Posted Speed Limit Attribution
Each county was mapped individually, and a visual inspection of RC posted speed limit and "first cut" speeds was performed to validate the "first cut" attribution. Any discrepancies in the initial coding were modified to reflect the RC database. The majority of the high-class facilities matched well with the initial assignment. However, the lower classed facilities exhibited a more diverse range of speed limits that required the majority of the "first cut" codes to be adjusted. The attributions were independently checked for quality assurance.

Figure 3.1
Speed Limit Assignment Methodology



Observations, Findings and Recommendations

As in the HPMS assignment, the RC database failed to provide posted speed limit information for the interstate facilities. Once again, the "first cut" codes were used verbatim unless definitive knowledge of a certain facility required an adjustment. Table 3.1 presents a distribution of speed limit attribution values by HPMS classification.

Table 3.1
Distribution of Post Speeded Limit by HPMS Classification

HPMS Code		Count of Speed Limit Values Attributed to ARC links – 2004										
		25	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**Totals**	**Avg. Speed**
Rural												
Interstate	1	-	-	-	-	-	-	168	-	127	295	59
Principal Arterial	2	14	10	23	-	31	22	184	-	84	368	53
Minor Arterial	6	41	32	122	21	157	26	400	-	4	803	47
Major Collector	7	51	125	222	64	516	102	362	-	-	1,442	44
Minor Collector	8	16	9	90	51	230	48	46	-	-	490	43
Local	9	128	96	341	146	328	42	175	-	-	1,256	40
Urban											**4,654**	
Interstate	11	-	-	-	-	332	-	1,028	-	256	1,616	55
Urban Freeway/Expressway	12	-	-	29	-	9	-	64	-	55	157	54
Urban Principal Arterial	14	80	67	619	118	1,040	119	379	-	20	2,442	43
Minor Arterial	16	533	547	2,001	646	2,025	72	175	-	-	5,999	38
Collector	17	568	719	1,580	298	745	12	38	-	10	3,970	35
Local	19	434	331	2,193	275	584	-	-	-	-	3,817	35
											18,001	

There are a few inconsistencies in the speed limit assignments, such as local facilities with a speed limit of 55 mph. Since ramps are coded as local, in terms of HPMS designation, some of the higher speeds can be attributed to the ramps. However, some local 55 mph rural facilities located in Coweta and Forsyth Countyappear to be out of place. A more detailed review of the GDOT-maintained RC database would provide insight into specific inconsistencies.

Appendix A
1995 - 2000 ARC Project List

ProjectTypeDefn	ARC #	Open Date	Net Yr	Description	From/At	To
SOV	GW 093B	2000	2000	SUGARLOAF PARKWAY	OLD PEACHTREE ROAD	BUFORD HWY
SOV	GW 136B	2000	2000	NORTH BROWN	SR 120	SEVER ROAD
SOV	GW 249B	2000	2000	NORTHMONT PKWY EXT.	NORTHMONT PARKWAY	SWEETWATER CREEK BRIDGE
SOV	GW 259	2000	2000	HOSEA ROAD	HURRICANE SHOALS	SR 316 / UNIVERSITY PARKWAY
SOV	HE 007B	2000	2000	Jonesboro Road (SR 920)	BIRCH CREEK	

Appendix B
2000 - 2004 ARC Project List

ProjectTypeDefn	ARC #	Open Date	Net Yr	Description	From/At	To
SOV	AT 017	2002	2003	SR 70-FULTON INDUSTRIAL BLVD	NORTH AVIATION CIR	US 78/278
SOV	AT 175	2004	2005	UNIVERSITY AVE	MCDONOUGH BLVD	METROPOLITAN PKWY (STEWART AVE)
SOV	AT-AR 178	2002	2003	I-285S TO I-20W (INTCHN./RAMP RECON. AND ASSOCIATED 6-LANE COLLECTOR/DISTRIBUTOR)	I-285	THORNTON ROAD (SR 6)
SOV	AT-AR 214	2003	2003	I-285 @ BANKHEAD HWY (INTCHN. RECON. AND ASSOCIATED 4-LANE COLLECTOR/DISTRIBUTOR)	I-20W	BOLTON ROAD (SR 70)
SOV	CH 018	2004	2005	BELLS FERRY RD	LITTLE RIVER	
SOV	CH 153	2002	2003	EAGLE DR	BELLS FERRY RD	TOWNE LAKE PKWY
SOV	CH 184	2001	2003	SIXES RD	BELLS FERRY ROAD	I-575
SOV	CL 031	2003	2003	SR 138	WALT STEPHENS RD	I-75 / HENRY CO
SOV	CL 052C	2001	2003	BETHSAIDA RD EXT, PHASE 3	ROBERTS DR	UPPER RIVERDALE RD
SOV	CL 059	2004	2005	I-75S	LEE STREET (BRIDGE)	
SOV	CL-AR 031	2004	2005	I-75S	MT ZION BLVD	OLD DIXIE & SR 54 INTERCHANGE
SOV	CL-AR 229	2004	2005	AVIATION BOULEVARD REDEVELOPMENT	WEST OF AIRPORT LOOP	PROPOSED INTERNATIONAL TERMINAL
SOV	CO 211D	2002	2003	ATLANTA ROAD	AUSTELL ROAD	SR 120 LOOP
SOV	CO 294	2003	2003	ROBERTS COURT EXTENSION	Barrett Parkway	Barrett Parkway
SOV	CO 300	2003	2003	FREY RD	0.1 MILE S OF I-75N bridge	0.1 MILE N OF I-75N bridge
SOV	CO-AR 078K1	2003	2003	MILL GREEN PKWY	AKERS MILL RD	INTERSTATE NORTH PARKWAY
SOV	CO-AR 078K2	2003	2003	MILL GREEN PKWY	AKERS MILL ROAD	INTERSTATE NORTH PKWY
SOV	CO-AR 180	2002	2003	I-285	PACES FERRY ROAD	
SOV	CW 009	2004	2005	SR 34	SHOAL CREEK	

Appendix B (Continued)
2000 - 2004 ARC Project List

ProjectTypeDefn	ARC #	Open Date	Net Yr	Description	From/At	To
SOV	GW 248	2002	2003	STEVE REYNOLDS BLVD	CLUB DR	SATELLITE BLVD
SOV	GW 253	2003	2003	SATELLITE BLVD	OLD NORCROSS RD	STEVE REYNOLDS BLVD
SOV	GW 254	2003	2003	SR 324 / GRAVEL SPRINGS RD	I-85	SR 20/BUFORD DR
SOV	GW 255	2003	2003	SR 324/Gravel Springs Road	I-85	SR 124/BRASELTON HWY
SOV	GW 257B	2003	2003	SATELLITE BLVD. EXT.	SMITHTOWN ROAD	SR 20 / BUFORD DR
SOV	GW-AR 053A	2004	2005	I-85N AT SR 316 (RECON/REALIGN AND INCL. HOV LANES)		
SOV	GW-AR 072E	2003	2003	I-85 CD SYSTEM	SUGARLOAF PKWY	OLD PEACHTREE RD
SOV	HE 003	2001	2003	BILL GARDNER PARKWAY	I-75	SR 42
SOV	HE 103	2001	2003	EAST LAKE RD EXT	SR 42 AT EAGLES LANDING PKWY	SR 155 AT EAST LAKE RD
SOV	HE 104	2003	2003	SR 20 (INCLUDING HAMPTON BYPASS)	US 19 & 41/ SR 3	I-75
SOV	HE 109	2001	2003	ROCK QUARRY EXT	SR 42	OLD CONYERS RD
SOV	HE 110	2002	2003	JODECO RD EXT	SR 42 / CAMPGROUND RD	JODECO RD
SOV	HE 118A	2001	2003	MCDONOUGH PKWY EXT - PHASE I	SR 42	JONESBORO ROAD
SOV	HE-AR 209	2003	2003	JONESBORO ROAD BRIDGE	I-75S	
SOV	HE-AR 215	2003	2003	I-75S	HUDSON BR RD/ EAGLES LANDING PKWY	
SOV	HE-AR 217	2001	2003	I-75	SR 155	
SOV	HE-AR 218	2001	2003	I-75	LOCUST GROVE ROAD	
SOV	HE-AR 219	2001	2003	I-75	SR 138	
SOV	PA 015	2003	2003	WEST HIRAM PKWY	US 278	SR 92
SOV	RO 023A	2004	2005	DOGWOOD DRIVE CONNECTOR	OLD COVINGTON HIGHWAY	END OF DOGWOOD DRIVE
SOV	RO 037	2004	2005	IRWIN BRIDGE RD	WEST CIR	MAIN ST

Appendix B (Continued)
2000 - 2004 ARC Project List

ProjectTypeDefn	ARC #	Open Date	Net Yr	Description	From/At	To
SOV	CW 009	2004	2005	SR 34	SHOAL CREEK	
SOV	CW 099	2004	2005	I-85S	SR 34 RAMP, SE QUADRANT	
SOV	DK 040A	2004	2005	BOULDERCREST RD	CONSTITUTION RD	I-285
SOV	DK 059	2004	2005	LITHONIA INDUSTRIAL BLVD EXT, PHASE II	ROGERS LAKE	ROCK CHAPEL RD
SOV	DK 215	2003	2003	PERIMETER CENTER PARKWAY EXT	HAMMOND DRIVE	LAKE HEARN DRIVE
SOV	DK 270	2004	2005	LITHONIA INDUSTRIAL BLVD (includes CSX RR Crossing), PHASE I	SOUTH STONE MTN-LITHONIA RD	ROGERS LAKE RD
SOV	FA 117	2003	2003	BANKS RD	SR 314	SR 85
SOV	FA 246	2003	2003	RAMAH RD	REDWINE RD	SR 85
SOV	FN 005	2001	2005	HAMMOND DR	GLENRIDGE RD	ROSWELL RD
SOV	FN 055	2001	2005	PEACHTREE-DUNWOODY RD	ABERNATHY RD	SPALDING DR
SOV	FN 127	2003	2005	OLD ROSWELL ROAD WIDENING	MARKET PLACE (GRIMES BR. RD)	COMMERCE PKWY
SOV	FN 132	2001	2005	MIMOSA BLVD EXT	MAGNOLIA STREET	WEBB STREET
SOV	FN 140	2003	2003	MANSELL RD EXT	CROSSVILLE RD (SR 92)	ALPHARETTA STREET
SOV	FN-AR 190	2003	2003	SR 400	WINDWARD PKWY	
SOV	FN-AR 203	2004	2005	I-285	ROSWELL ROAD (US 19 SOUTH/SR 9)	
SOV	FS 036A	2002	2003	SOUTH FULTON PKWY	SR 154	COCHRAN MILL RD
SOV	FS 048	2002	2003	SR 70 - FULTON INDUSTRIAL BLVD	INTERCHANGE DR	NORTH AVIATION CIR
SOV	FS 056	2001	2003	OAKLEY IND BLVD	SENOIA RD	BOHANNAN RD
SOV	FT 001	2004	2005	SR 9	SR 141	SR 20
SOV	FT 007	2003	2003	MCFARLAND RD	SR 9	SR 400
SOV	FT 007A	2003	2003	SR 400	MCFARLAND ROAD	
SOV	FT 015	2003	2003	MCFARLAND RD	MCGINNIS FERRY RD	SR 400
SOV	GW 045	2002	2003	SR 20 EXTENSION	JACKSON STREET	CSX R/R SOUTH OF INDUSTRIAL CIRCLE
SOV	GW 093C	2003	2003	SUGARLOAF PKWY	BUFORD HWY	PEACHTREE IND BLVD
SOV	GW 247	2002	2003	CLUB DR	PLEASANT HILL RD	STEVE REYNOLDS BLVD